Global Adoption and Modification of the World Health Organization (WHO) Surgical Safety Checklist

Scholarly Report submitted in partial fulfillment of the MD Degree at Harvard Medical School

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Student Name: Alexander J Blair, M.S.

Scholarly Report Title: Global Adoption and Modification of the World Health Organization (WHO) Surgical Safety Checklist

Mentor Name(s) and Affiliations: William R. Berry, MD, MPA, MPH, FACS, Ariadne Labs, Harvard School of Public Health & Brigham and Women's Hospital

Collaborators, with Affiliations:
Atul Gawande, MD, MPH Ariadne Labs, Harvard School of Public Health & Brigham and Women's Hospital
Joshua Baugh, MD University of California, Los Angeles, Department of Emergency Medicine

ABSTRACT:

TITLE: Global Adoption and Modification of the World Health Organization (WHO) Surgical Safety Checklist

Alexander Blair, Joshua Baugh, Atul Gawande, William Berry

Purpose: To understand how hospitals have modified the checklist globally.

Methods: 126 checklists were studied from 37 countries and 19 US states. Checklists were analyzed for trend and were provided a teamwork score based on how many communication items were retained. Checklists modifications were aggregated and analyzed geographically.

Results: Modified checklists contained more total items as compared to the original, averaging 33.5 ±8.4 items versus 28 in the original. The most commonly added items were procedural, not teamwork-based. 50% of all checklists removed two or more of the original seven teamwork items. Surgeon-led items were more likely to be removed. The average number of teamwork items on US checklists was significantly lower than on non–US checklists (3.98 vs. 5.64, $p<0.05$). US checklists were also more likely to eliminate all surgeon-led items (21.4% of US vs. 12.7% of all checklists).

Conclusions: Checklists should strike a balance between critical items and teamwork checks, meanwhile ensuring the checklist is feasible in length. Hospitals, while eager to add items, are primarily adding procedural checks, but not necessarily preserving essential teamwork and surgeon-led items. We recommend hospitals preserve all teamwork and surgeon-led items, but limit checklist length to ensure feasibility.

Contents

Section I: Introduction

There is an imperative need for improved communication and teamwork within surgical teams. A growing body of research links improved operating room communication and teamwork with lower frequencies of errors and improved outcomes[1,2,3] In 2008, the World Health Organization (WHO) published the Surgical Safety Checklist towards this aim. This checklist seeks to reduce complications and surgical mortality through encouraging proactive communication, effective teamwork, and focusing on critical steps.[4] Lessons from the aviation industry recommend that checklists also focus on 'killer items,' or those steps that are most critical, known to be overlooked, and that put the patient at highest risk of harm when omitted.[5] The WHO checklist was designed around operational work-flow patterns, when critical steps have been completed, while still allowing for remediation of these items.[6] The three phases of operation include: 1) before induction of anesthesia ("sign in"), 2) before the incision of the skin ("time out"), and 3) before the patient leaves the operating room ("sign out").[7] This tool has been shown to reduce complications and surgical mortality.[8] Since its publication, over 4,000 hospitals have adopted the WHO Surgical Safety Checklist.[9] Modification of the checklist to fit local practice is encouraged to foster ownership, facilitate use, and cater to site-specific practices.[10,11] The modification process can make the checklist more or less effective depending on the changes made.

A number of studies have demonstrated the need for improvement in communication and teamwork within surgical teams.[12,13,14] The WHO Surgical Safety Checklist is designed to foster a safety culture. Certain checklist items, when deleted, will likely diminish checklist efficacy, particularly those designed to promote teamwork and communication. While surgeons tend to believe their OR's teamwork and communication is optimal, nurses and anesthesiologists do not agree.[15,16,17] Removal of surgeon-led items promoting communication would likely increase mortality rates. The WHO checklist contains seven teamwork and communication items: 1) the introduction of all team members by name and role, 2) the surgeon sharing the critical or non-routine steps,

3) expected procedure duration, and 4) anticipated blood loss; 5) the anesthesia provider sharing their patient and anesthetic concerns; 6) the nursing team sharing their concerns; and 7) the entire team discussing the key concerns for recovery and management before the patient leaves the OR. Use of the WHO checklist has been shown to enhance surgical safety and teamwork attitudes. Effective use of the checklist is associated with improvement in safety attitudes and decreased post-operative mortality. [18,19]

This study aimed to understand how hospitals have modified the checklist globally. Developing an understanding of modifications can guide both future implementation efforts and design of updated versions of the WHO checklist. While the presence of a given item on a certain checklist does not guarantee adherence in clinical practice, items retained can provide valuable insight into the checklist items and prompts that hospitals value and believe require the most attention. Alternatively, absence of original WHO checks and prompts may suggest that hospitals perceive particular checklist items as unnecessary, cumbersome, or too difficult to implement in their hospital.

Section 2: Student role

Personal Contribution

My contribution consisted of design and execution of the United States-related checklists. Initially, this consisted of a comprehensive literature review of publications related to surgical safety checklists and operating room communication quality improvement. Subsequently, I was involved in the design of the aspect of the study that involved United States checklist analysis. I collected 31 novel checklists and reviewed all previously collected checklists from prior collaborators.

Upon data collection for all United States checklists, I conducted a thorough analysis of the differences between both United States and international checklists. In particular, updating the teamwork score and analyzing the designation of checklists to the three distinct providers involved in checklist implementation (e.g. surgeons, anesthetists, and nurses).

Upon collecting all relevant data, I wrote the introduction and discussion sections in full, as well as significantly updated previously written methods and results sections. Figures were also updated accordingly. This work was then aggregated into a poster presentation as well as the manuscript included here. The poster was then presented at the American College of Surgeon's Medical Student Forum in 2015 and this publication was drafted for submission in 2016.

Field Contribution

This work strives to guide current efforts to improve surgical safety through improved operating room communication and teamwork. Surgical safety checklists have been validated as a tool to improve outcomes and reduce errors, but this has only been within the confines of a study period. To date, there have been no reviews of checklist implementation outside of the scrutiny and aid of a study trial.

Through this study, we have conducted a comprehensive review of as many surgical safety checklists that are available within the dates of this study. By collecting and subsequently analyzing nearly 130 checklists, we have developed a unique perspective as to how checklist are modified globally. Modification of checklists, as seen through the checklists included in this study, we are able to understand how checklist are implemented and utilized internationally. Such an analysis is important for surgical safety checklist research as it allows for a more thorough understanding for checklist implementation efforts. While we now know that checklist usage within operating rooms is an effective method to improve teamwork and communication, it is less clear how they serve long-term. Do checklists deteriorate over time? Does the initial energy and excitement over checklists wane, and as such, result in "checklist fatigue" and an ineffective tool?

By conducting this study and thoroughly analyzing how checklists have been modified from their initial conception, we have an opportunity to understand whether checklists are effective through one-time implementation efforts. If they are not, would checklist sites benefit from a quality improvement effort wherein checklists could be reviewed and updated periodically?

Through this research, we aim to determine whether checklist implementation and modification has been occurring for the better for the past eight years, since the original WHO surgical safety checklist was disseminated. But in addition, we will provide insight as to how to improve modification moving forward and mechanisms to prevent checklist deterioration long-term.

Section 3: Methods

The number and distribution of hospitals using the WHO Surgical Safety Checklist worldwide is unknown. Obtaining a truly random sample of checklists was therefore not feasible. Given this limitation, we gathered a large sample with wide geographic representation.

Checklists were collected in three ways: 1) checklists were sent to us in response to a general request for modified versions, 2) found through extensive searches online, and 3) obtained through contacts of the research team. In order to qualify for analysis, a checklist was required to be: 1) from an identifiable hospital, 2) adapted from the WHO checklist, 3) applicable to broad surgical practice (i.e. not just for a specific subspecialty), and 4) readable in its entirety. A checklist that met any of the following criteria was considered to be an adaptation of the WHO checklist: 1) if it mentioned the WHO in its text or in accompanying materials, 2) if its creators informed the authors that it was based on the WHO checklist, or 3) if it had three discreet sections (i.e. before induction of anesthesia, before skin incision, and before the patient leaves the OR).

202 checklists were initially collected. 30 were designed for specific subspecialties (i.e. ophthalmology, ENT, obstetrical, ambulatory, etc), 9 could not be associated to a specific hospital, and 5 were deemed not to be WHO adaptations. Of the remaining 158, 22 were created by national government organizations, national patient safety organizations, and national specialty societies. 10 were created by state or regional organizations and the remaining 126 were created by individual hospitals. Regional and national organization checklists were largely not included as they were deemed an inaccurate representation of checklists in actual use in individual hospitals. However, for

seven countries in the sample, the only checklist available was a nationally created checklist; in order to maximize geographic representation, the national checklist was used as a proxy for a local checklist in that country. This ultimately resulted in a final sample size of 126.

Checklists were analyzed using a set of yes/no questions and quantitative measures. Yes/no questions included assessment of the presence of each original WHO item, and the presence of additional items identified as commonly present in a preliminary analysis (Table 1). The total number of items was determined for each checklist, as was the number of original WHO items present. Checklist features that did not elicit an answer or discussion, such as signature boxes, comment boxes, listing of team members, places for patient labels, etc, were noted, but not included in the item count. The checks and prompts could be answered affirmatively, negatively, or to elicit discussion of a topic not addressed elsewhere in the same section of the checklist. In order to be considered a new item, the check or prompt had to bring up an issue not addressed in the original WHO checklist. For example, a check discussing IV access or availability of fluids, in addition to blood loss, was not counted as an extra item, as the WHO blood loss check addresses both IV access and fluid availability. Confirmation that a blood cross match had been performed was counted as a new check because the WHO Checklist does not specifically address blood typing. The item count was therefore a reflection of the number of separate issues addressed by a given checklist, without regard to specific choices in wording and/or formatting.

Seven WHO prompts were categorized as addressing teamwork and communication. These prompts were:

1. *Introduction of team members by name and role*. The prompt needed to promote the introduction of team members to each other out loud. Confirmation that all names were on a white board or written elsewhere was not sufficient, as this could be accomplished without the team saying their names aloud.

2. *Discussion of the surgical plan by the surgeon*. Any prompt that required the surgeon to share the procedural plan was included: discussion of "critical, key, important events," "the surgical plan," "unexpected steps," or similar phrases.
3. *Statement of expected procedure duration by the surgeon*.
4. *Statement of estimated blood loss by the surgeon.* If this issue was discussed without a requirement that the surgeon be present, this was not sufficient. The purpose of this prompt is to elicit sharing of this information with the entire team by the surgeon.
5. *Sharing of patient specific concerns by the anesthesia provider.* Any prompt that required the anesthesia provider to discuss patient concerns with the team was included. Discussion of "safety precautions" was not sufficient, nor was any discussion without the surgeon present.
6. *Sharing of concerns by the nursing team*. Any prompt that required the nursing team to discuss concerns that they had with the entire surgical team present.
7. *Discussion of the key concerns for post-operative care by the surgical team*. Any items prompting discussion of key concerns for recovery and management of the patient, including discussion of "important aspects of recovery," "post-operative management," or "critical information for treatment," were included. At a minimum, this prompt needed to include the nurse, anesthesia provider, and surgeon in the discussion to ensure that all team members were informed about critical information.

The 56 U.S. checklists were also compared with the 70 international hospital checklists. As the two groups were of different sizes and unknown variances, the most conservative t test, Welch's, was used to assess continuous variables (average number of items per checklist, average number of original WHO items per checklist, and average teamwork score). A Fisher test was used to compare discreet variables (i.e. the number of checklists containing a given item).

Section 4: Results

126 checklists comprised the final sample from 37 countries and US states. Further sample characteristics are listed in Table 2. The WHO Checklist contains 28 individual checks and prompts. On average, the checklists studied contained 33.5 +-8.4, 5.5 more items than the WHO checklist. A wide variety of different items were added to checklists, and the majority of these involved the completion of checks, such as specific safety processes, while a smaller number aimed to augment processes, such as operating room communication and/or system improvements. The most commonly added checks were: the availability of proper implants (56.3 % of checklists), DVT prophylaxis (51.6%), and proper patient positioning (50.0%). A more complete list of commonly added checks and prompts can be found in Table 3.

Checklists studied had an average of 33.5 (SD=8.4) of the 28 original WHO checklist checks and prompts. 10.3% of checklists contained all 28 of the original checks/prompts, while 23.0% contained fewer than 22 of the original. The lowest observed number of original checks/prompts on a checklist was 11. By far, the most commonly omitted WHO check was, "Is the pulse oximeter on the patient and functioning?", which was absent on 54.0% of total checklists and 73.2% of US checklists. The next three most commonly omitted checks were nurse concerns (53.2% total and 50% of US), expected duration (omitted on 31.7.0% of total and 41.1% of U.S), and sterility check (27.0% total and 37.5% U.S.). A more complete list of omitted WHO checks and prompts can be found in Table 4.

Teamwork and communication prompts were often omitted from the checklists studied. 25.4% of checklists retained all seven WHO teamwork and communication prompts, while 24.6% of checklists omitted one, 3.2% omitted two, 2.4% omitted three, and 29.4% omitted three or more prompts. The following prompts were frequently omitted: nurse concerns (53.2% omitted), expected duration (31.8%), and anticipated blood loss (24.6%). The discussion of key concerns for recovery and management of the patient was the prompt that was the least frequently omitted (7.9 %). The average number of teamwork and communications prompts on a given checklist was 5.64 ±2.2.

A comparison of US checklists with non-US checklists revealed stark differences in some areas (Table 5). US checklists contained significantly fewer original WHO checks and prompts on average (22.2 vs. 24.8, p = 0.0006). The average number of communication and teamwork prompts on US checklists was also significantly lower than on non–US checklists (3.98 vs. 5.64, p=0.0073). Four of the seven teamwork and communication-prompts appeared less frequently on US checklists. The difference in frequency between the two groups was statistically significant for the following prompts, sharing of critical or non-routine steps by the surgeon (69.6% vs. 90.0%, p=0.0011), discussion of estimated blood loss by the surgeon (66.1% vs. 82.3%, p=0.0272), sharing of patient concerns by the anesthesia provider (69.6% vs. 92.9%, p = 0.0009), and the discussion of key concerns for recovery and management by the entire surgical team (83.9% vs. 98.6%, p=0.0055).

Section 5: Discussion, Limitations, Conclusions

Since 2008, hospitals around the world have extensively modified the original WHO Surgical Safety Checklist in implementing their own checklist. Innovations that are modified and adapted to local circumstances are more likely to be successfully adopted.[20,21] The original WHO Surgical Safety Checklist encourages additions and modifications to fit local practice for this reason. Nonetheless, checklist designers discourage elimination of any safety step, unless incorporated into another process. Also, designers warn of onerous addition of too many items because lengthy checklists are not as effective.[22] For the checklists evaluated in this study, checks increased overall. While procedural checks increased on average, teamwork and surgeon-led checks decreased.

Checks increase overall

The average number of checklist items increased overall from the original WHO checklist. The WHO checklist was created to be relatively concise because airline industry experts advise that lengthy checklists can lose some of their utility and usability.'[23,24] The ideal length for a surgical checklist has not been determined, although evidence from aviation suggests that no more than 7-9 checks and prompts be in each section, while the entire checklist should be no more than a single page if possible.[2514,15]

Given that the WHO checklist contains three sections, there should be approximately 21-27 checks. In our study, the average number of checks was 32.5 for all and 35.1 for US hospitals. These results are promising, indicating that hospitals are enthusiastic about the checklist since they are adding items, but concerning in that longer checklists will have diminishing returns. Longer checklists may be too cumbersome and may take longer to complete than the recommended 60 to 90 seconds per section[26]. Adding more checks and prompts increases the likelihood that items will be skipped, not discussed, or the checklist discarded in its entirety.

Procedural checks increase & teamwork checks decrease

Checks were classified as either procedural or communication-based. Of the checklists analyzed, hospitals generally added procedural checks and removed communication checks. Both trends were amplified for US hospitals. The most frequently added procedural checks included: 1) verify implants, 2) DVT prophylaxis, 3) patient positioning, and 4) hypothermia prevention measures. Many of these items were added in order to meet regulatory requirements. In order for completion of checklists to remain feasible in 60 to 90 seconds per section, hospitals should consider removing checks that are adequately addressed by other processes.

Prompts that facilitate discussion between surgical team members should not be removed; even though they might be difficult to put into routine use. The most frequently removed teamwork checks were: 1) nurse concerns for patient, 2) expected procedure duration, and 3) team introduction. Checks that promote teamwork and communication are some of the most important on the WHO checklist. Better communication by residents and attendings has correlated with improved risk-adjusted mortality, whereas poor teamwork and decreased information sharing correlates with increased complication and/or death.[27] [28] The WHO Surgical Safety Checklist was designed to encourage more open communication in the OR. Studies of industry group dynamics suggest that colleagues are more comfortable voicing concerns and giving constructive feedback if there is a prominent safety culture with strong team dynamics. This is often referred to as, voice climate.[29] Voice climate depends on past experiences with open communication

and whether ideas are accepted and valued by team leaders.[30] Team introductions, such as during "time out", are designed to cultivate a better voice climate. This prompt encourages team members to speak before skin incision; setting a precedent that input from the whole team is valued. If team communication prompts are removed or not used, voice climate and patient safety will suffer.

Surgeon-led checks decrease

Surgeon-led items were most frequently removed in our checklist sample. While removing any teamwork and communication items counters recommendations by the aviation industry and checklist architects, omitting surgeon-led communication and teamwork items is particularly concerning. Studies suggest that surgeons have an inflated positive perceptions of OR communication and teamwork. In a British study, 51% of nurses did not consider the surgeon a team player and 72% of nurses felt communication and teamwork was lacking in the OR. These discrepancies in the perception of teamwork and communication between surgical team members likely exacerbates poor communication, such as comfort with mentioning safety errors as they arise. There are many possible reasons for the observed trend of fewer surgeon-led checklist items, such as surgeons assuming communication is already optimal or not buying into the checklist culture.[10,11] Despite the underlying reason, future implementation efforts should strive to ensure surgeon-led teamwork items are retained and that all team members have an opportunity to voice patient concerns. Checklists that eliminate all of the prompts eliciting a discussion led by the surgeon (12.7% of all checklists and 21.4% of US checklists) miss an opportunity to greatly improve OR communication. As the perceived leader of the team, the surgeon sets the tone for the voice climate in the operating room. When the surgeon actively participates in discussion and encourages communication, team dynamics will likely improve, leading to greater opportunities for preventing errors and reducing complications.

The balancing act

Checklists should strike a balance between critical item and teamwork checks, all the while ensuring the checklist can be completed in 60 to 90 seconds per section. The

observation that 74.6% of all sites did not keep the seven teamwork checks, but that 5.5 critical checks were added on average is concerning. Hospitals, while eager to add items, are primarily adding procedural checks, but not necessarily preserving essential teamwork checks. US hospitals were more likely than non-US hospitals to lengthen their checklists, but remove teamwork checks. The observed trend of hospitals removing surgeon-related prompts is also worrisome. There is a discrepancy in the perception of quality and safety between surgeons and other health professionals, so preserving surgeon-related prompts is paramount. Given these results, we strongly recommend hospitals preserve teamwork prompts and use the checklist to diligently establish a culture of safety and quality improvement. Hospitals should devise a mechanism to review checklists periodically and ensure revisions are made to reflect this critical balance between critical items and teamwork. Future study is warranted to explore how to ensure teamwork and surgeon-led checks are preserved, and that the overall checklist does not become cumbersome in length.

Limitations

While this study provides insight into the many ways in which the WHO checklist has been modified, the generalizability of our sample is lacking. A truly representative, we could not obtain a randomized sample. To address this concern, a large and diverse sample was collected. However, certain types of hospitals may have been more likely to submit a checklist, potentiating sample bias. Also, checklists in English were easier to obtain checklists than checklists written in other languages.

This sample was not of sufficient size to allow for a more granular geographic analysis. There are possibly differences in the modification between non-US countries based on cultural, geographic, and socioeconomic variables. Comparing US hospitals with non-US countries hospitals elucidates US-specific changes, but does not provide insight into the differences specific to other countries. Although we had access to checklists themselves, information about checklist effectiveness, such as influence on surgical environment and patient outcome was not available. These types of analyses

were beyond the scope of this study, but the relationship between different versions of checklists and usability or outcomes merits future inquiry.

Conclusions

This study provides the first view into global modification of the WHO Surgical Safety Checklist. The checklist has undergone extensive modification in diverse settings around the world. Many hospitals have lengthened their checklists by adding more process checks than those outlined by the WHO, and many have eliminated communication and teamwork-oriented prompts, especially surgeon-led; this trend is amplified in US hospitals. The frequent lengthening of checklists reflects commendable enthusiasm to use the checklist to further improve quality. Future implementation efforts should harness this energy to ensure teamwork and surgeon-led checks are preserved, while preventing checklists from becoming too lengthy.

Section 6: Acknowledgements

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Tables and Figures

WHO items	**New Items**
Identity Confirmed	Weight Confirmed
Site Confirmed	Patient Position Confirmed
Procedure Confirmed	Antibiotic Re-Dose Arranged
Consent Confirmed Pre-Anesthesia	DVT Prophylaxis In Place
Site Marked	Hypothermia Prevention Addressed
Anesthesia Safety Check Complete	Implants Ready
Pulse Oximeter On/Functioning	Beta Blockers Necessary?
Known Allergies Acknowledged	Blood Cross Match Confirmed
Difficult Airway/Aspiration Risk Assessed	Glucose Control Addressed
Risk of Blood Loss Assessed	Fire Risk Diminished
Prophylactic Antibiotic Given	History and Physical Present
Team Introduction	Lab Work Available
Patient Name Reconfirmed Pre-Incision	Post-Op Destination Ready
Procedure Reconfirmed Pre-Incision	Irrigation/Medications Accounted For
Site Reconfirmed Pre-Incision	Elicitation of Final Questions/Concerns
Critical Events Addressed by Surgeon	Explicit Invitation to Speak Up
Expected Duration Addressed by Surgeon	More Specific Debrief Question
Estimated Blood Loss by Surgeon	Quality Improvement Debrief
Patient Concerns by Anesthesia	Discussion of Intra-Operative Events
Sterility Confirmed	Discussion of Errors
Equipment Issues Discussed w/ Surgeon	Measure to Eliminate Distractions
Necessary Imaging Displayed	**Other Features**
Procedure Name Confirmed Post-Op	Space For Comments/Observations

Counts Are Correct	Extra Pause Point
Specimens Labeled Correctly	Signature Requirement
Equipment Problems Are Addressed Post-Op	Identification Of Team Members Present
Critical Issues for Recovery Discussed	Place For Patient Identification/Label

Table 1: Items counted for all checklists analyzed.

Checklists collected	113
Languages represented	14
Countries represented	37
North American	51
South American	4
European	39
Asian	11
African	6
Oceanian	2
US checklists	44
Non-US checklists	69
US States represented	19

Table 2: Characteristics of the checklist sample.

Countries Represented: **North America:** United States, Canada. **South America:** Argentina, Brazil, Peru, Uruguay. **Europe:** United Kingdom, Spain, Finland, Germany, Denmark, Norway, Romania, Switzerland, Italy, Turkey, Sweden, France, Poland, Belgium. **Asia:** Kuwait, Bahrain, Saudi Arabia, India, Phillipines, Japan, Thailand, Jordan, Malaysia, Azerbaijan, Iran. **Africa:** South Africa, Sierra Leone, Mozambique, Niger, Egypt. **Oceania:** Australia.

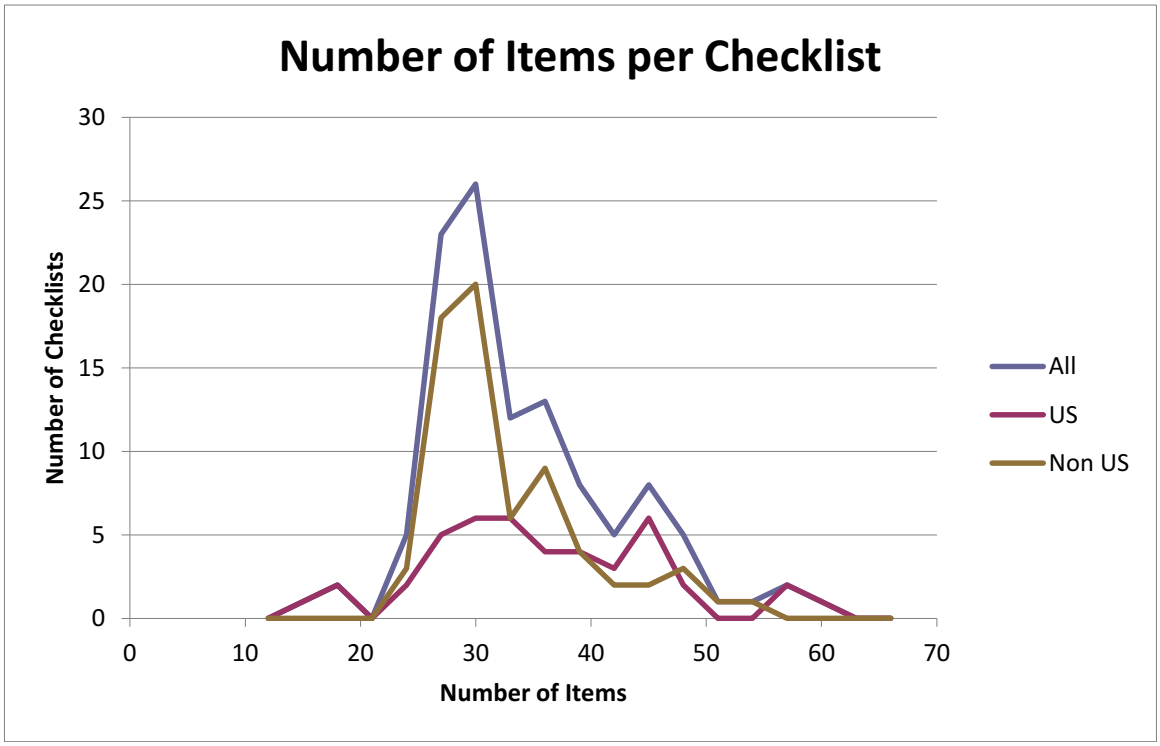
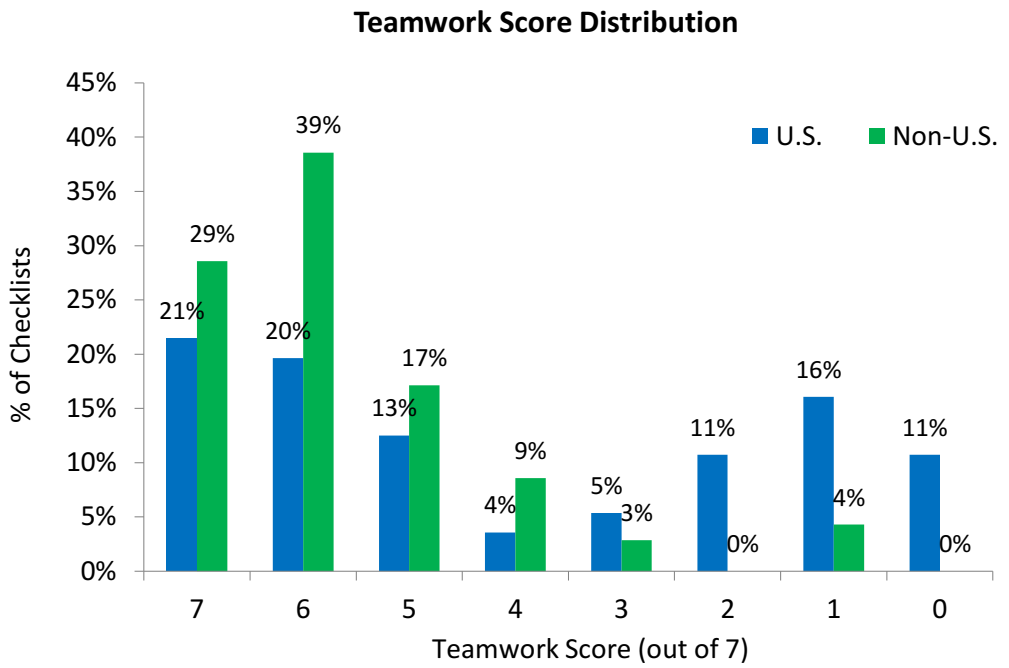


Figure 1: Number of items per checklist for the entire sample, the US sample, and the non-US sample.



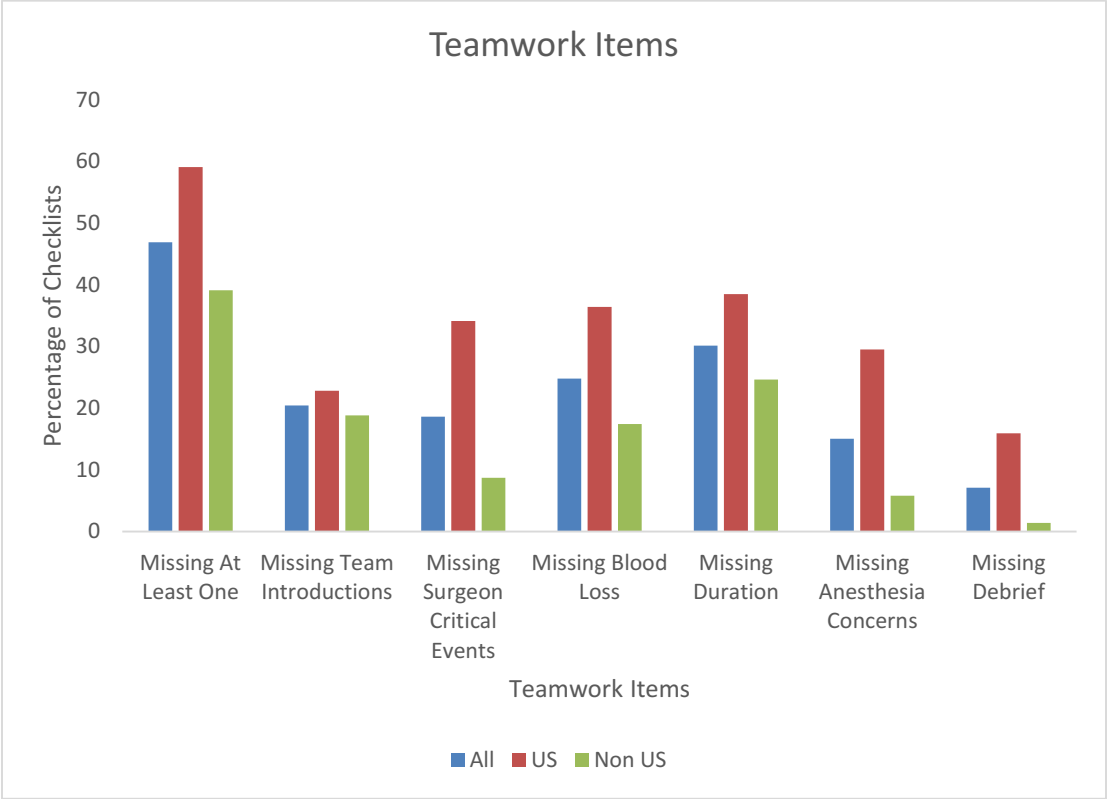


Figure 2: Top) Percentages of checklists with different teamwork scores. Bottom) Percentages of checklists missing specific teamwork items.

	% of total checklists with item (n=113)	% of US checklists with item (n=44)	% of non-US checklists with item (n=69)
Implants checked	54.0	90.9	30.4
DVT prophylaxis	48.7	59.1	42.0
Patient positioning confirmed	46.9	65.9	34.8
More specific debrief enacted	38.9	36.4	40.6
Hypothermia prevention	37.2	56.8	24.6
History and physical available	31.0	43.2	23.2
Lab work available	25.7	22.7	27.5
Blood match performed	19.5	22.7	17.4
Beta-blockers needed?	18.6	40.9	4.3
Meds on the field identified/labeled	17.7	36.4	5.8
Glucose checked	15.0	15.9	14.5
Antibiotic re-dose planned	13.3	20.5	8.7
Elicitation of final questions before incision	12.4	15.9	10.1
Quality Improvement Debrief	11.5	13.6	10.1
Comment Box	11.5	9.1	13.0
Fire Risk Assessment	10.6	25.0	1.5

Table 3: The frequencies with which each of the most common items were added to checklists.

	% of total checklists (n=113)	% of US checklists (n=44)	% of non-US checklists (n=69)
Pulse oximetry	47.8	27.3	60.9
Expected duration	69.9	61.3	75.4
Estimated blood loss	75.2	63.6	82.6
Sterility check	75.2	63.6	82.6
Anesthesia equipment safety check	75.2	59.1	85.5
Team introduction	79.6	77.3	81.2
Equipment problems addressed post-op	80.5	75.0	84.1
Surgeon discusses critical events	81.4	65.9	91.3
Equipment issues discussed with surgeon	82.3	79.5	84.1
Risk of blood loss assessed pre-anesthesia	85.0	75.0	91.3
Patient specific anesthesia concerns elicited	85.0	70.5	94.2

Table 4: The retention frequencies of the most commonly omitted original WHO checklist items among sample checklists.

	US (n=44)	Non-US (n=69)	P Value
Team introduction	77.3	81.2	0.6384
Surgeon discusses critical events	65.9	91.3	0.0011
Expected duration	61.3	75.4	0.1420
Estimated blood loss	63.6	82.6	0.0272
Anesthesia patient concerns	70.5	94.2	0.0009
Team debrief	84.1	98.6	0.0055
% Missing at least one teamwork item	59.1	39.1	0.0530
Average teamwork score out of 6	4.23 (SD = 2.08)	5.23 (SD = 1.25)	0.0017
Average # of items	34.9 (SD = 10.0)	31.8 (SD =6.7)	0.0721
Average # of WHO items	21.8 (SD =4.0)	24.4 (SD =2.7)	0.0003

Table 5: US vs. non-US checklists for teamwork items and other key characteristics